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**Kucharczyk et al.**

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(45) **Date of Patent: Oct. 9, 2001**

(54) **LOCKING MECHANISM FOR USE WITH ONE-TIME ACCESS CODE**

(75) Inventors: **David Kucharczyk**, Santa Fe, NM (US); **Suzy Brown**, Menlo Park, CA (US)

(73) Assignee: **Atlantes Services, Inc.**, Menlo Park, CA (US)

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(51) **Int. Cl.**[7] ..... **G08B 13/14**

(52) **U.S. Cl.** ..... **340/568.1**; 235/382.5; 340/5.2; 340/543

(58) **Field of Search** ..... 340/568.1, 542, 340/543, 545.6, 825.31, 825.34, 825.35, 5.2, 5.21, 5.22, 5.26; 235/382.5

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|---|---|---|---|---|
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| 5,673,034 | * | 9/1997 | Saliga | 340/825.31 |
| 5,774,053 | * | 6/1998 | Porter | 340/568.1 |
| 5,936,221 | * | 8/1999 | Corder et al. | 235/380 |

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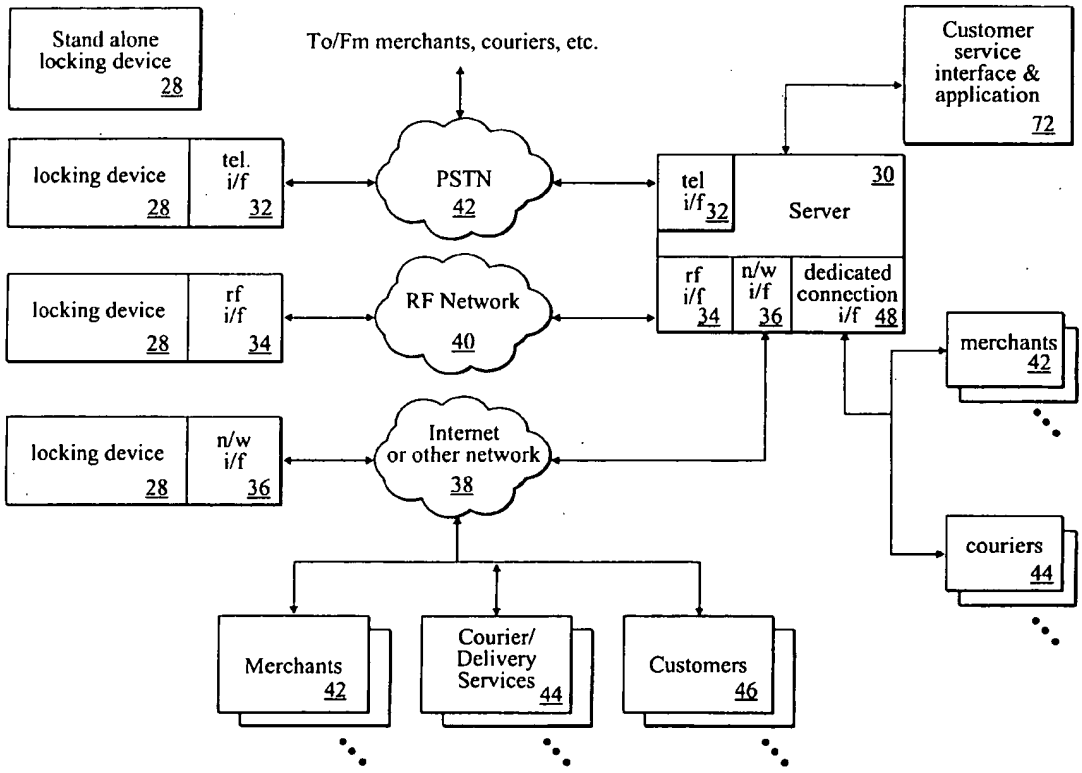
*Primary Examiner*—Thomas Mullen
(74) *Attorney, Agent, or Firm*—Blakely Sokoloff Taylor Zafman LLP

(57) **ABSTRACT**

A request for an access code for a locking mechanism is received; and a one-time use access code for the locking mechanism is subsequently issued. The one-time use access code may be issued from a list of currently available access codes for the locking mechanism in response to a request therefor, for example by a merchant or delivery service. Such a code may be issued by a server, which server is further responsible for updating the list of available access codes in response to an indication that a code has been used or has otherwise expired. The list of currently available access codes is preferably a subset of all access codes for the locking mechanism, which codes may be generated using a cryptographically strong random number generator.

**41 Claims, 6 Drawing Sheets**



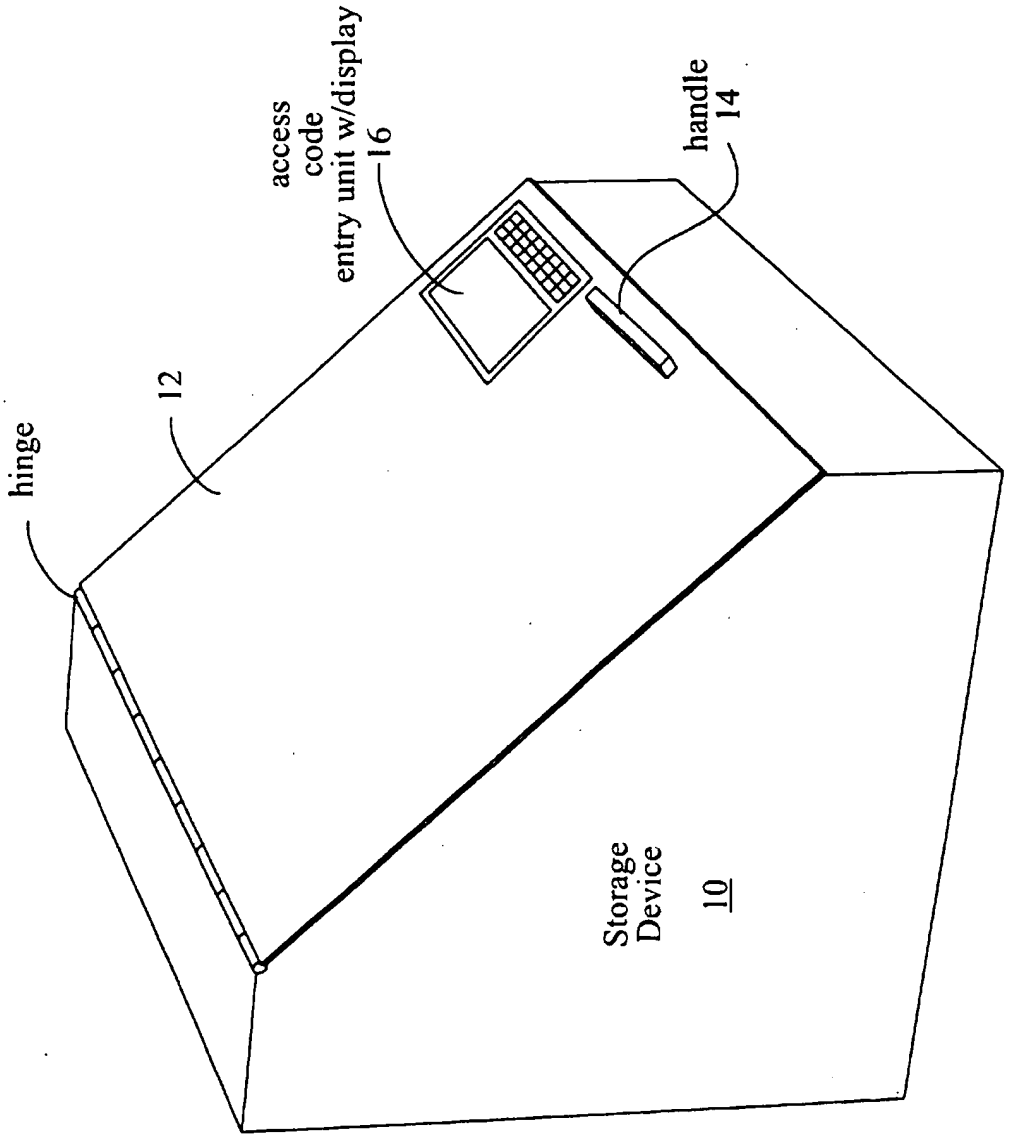

hinge
12
access code entry unit w/display 16
handle 14
Storage Device 10

Fig. 1

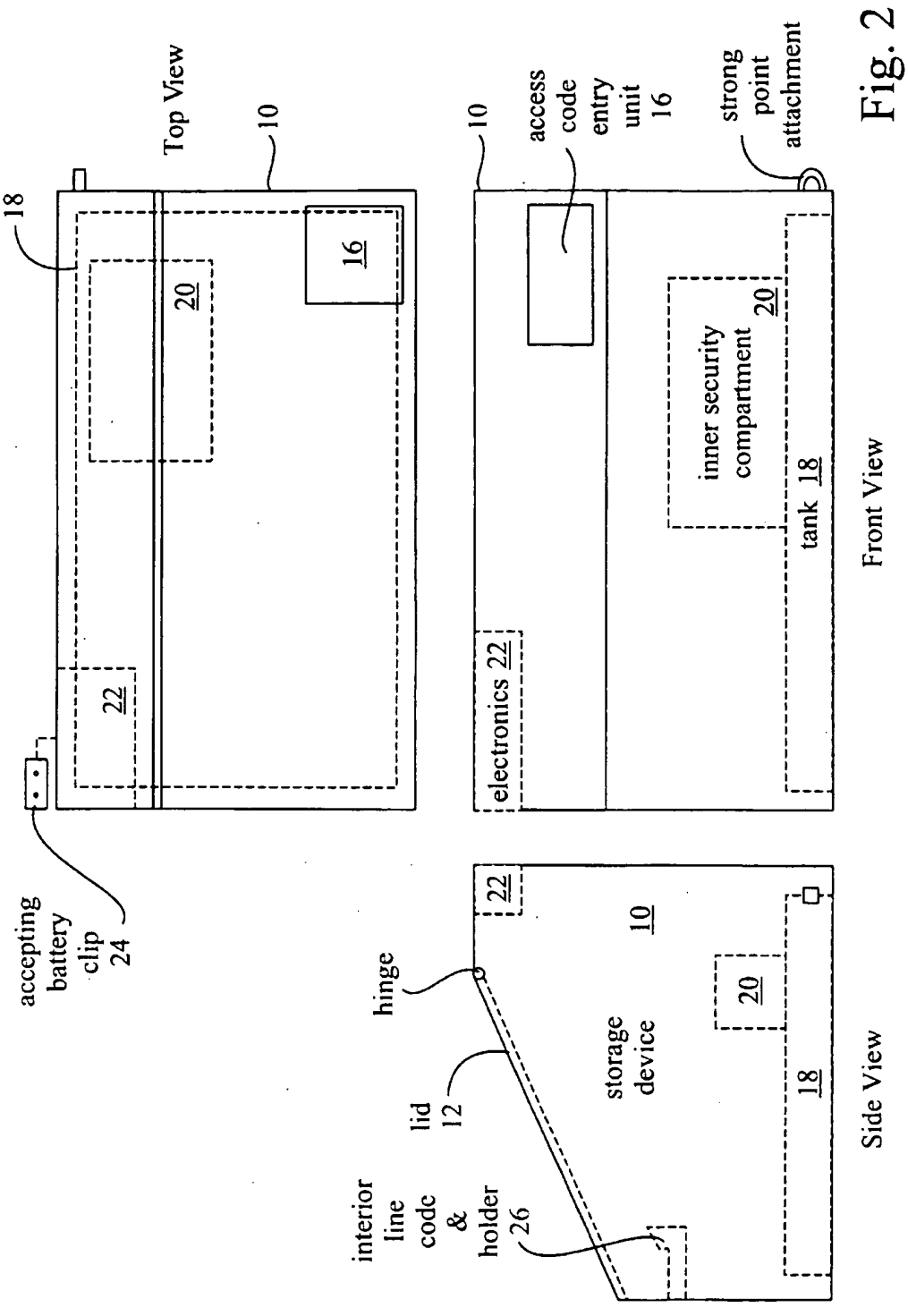

Top View
10
18
16
20
22
accepting battery clip 24
10
access code entry unit 16
strong point attachment
inner security compartment 20
tank 18
electronics 22
Front View
22
10
hinge
lid 12
storage device
20
18
interior line code & holder 26
Side View

Fig. 2

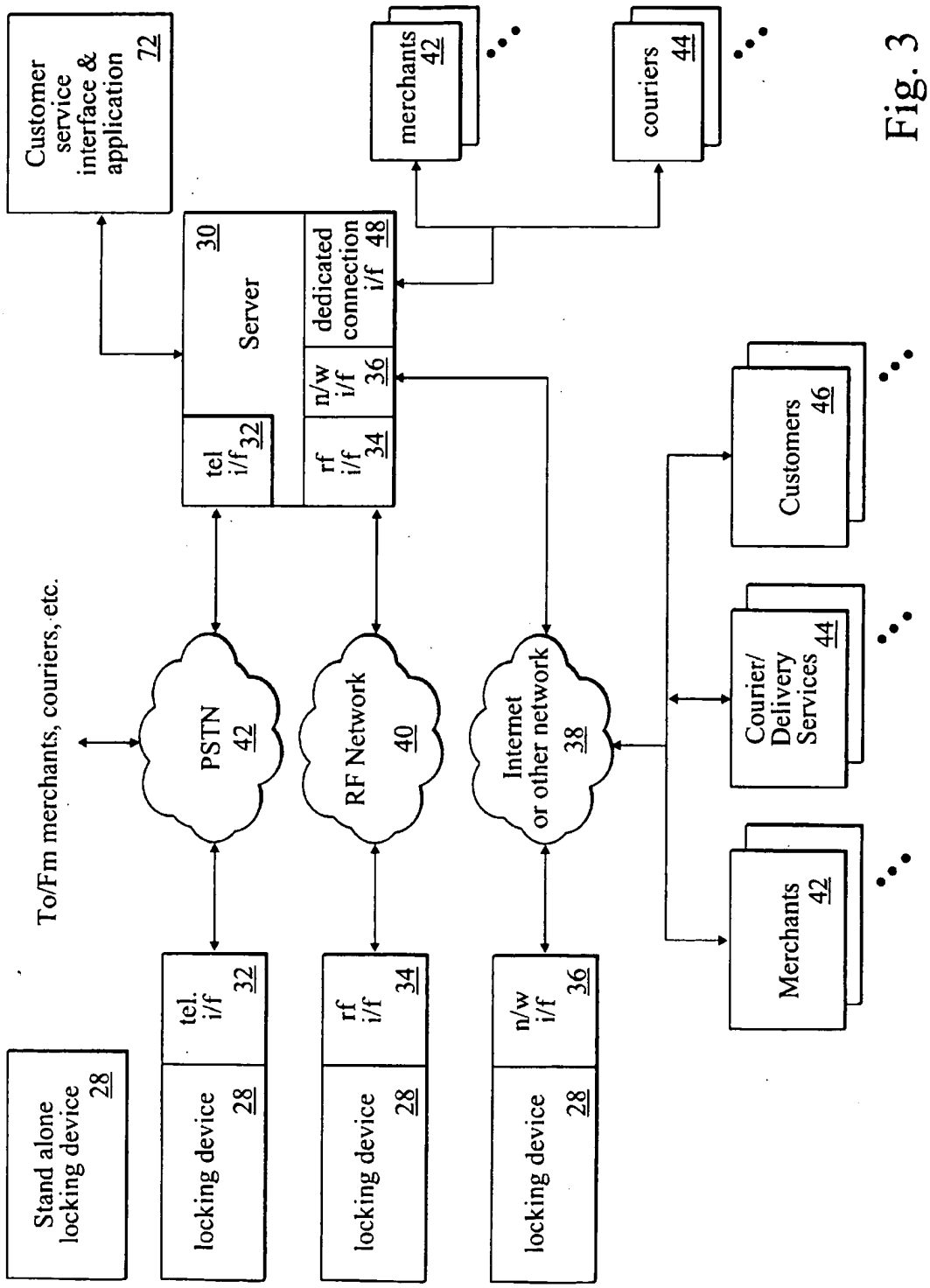

Customer service interface & application 72
merchants 42
couriers 44
Server 30
tel i/f 32
rf i/f 34
n/w i/f 36
dedicated connection i/f 48
To/Fm merchants, couriers, etc.
PSTN 42
RF Network 40
Internet or other network 38
Customers 46
Courier/ Delivery Services 44
Merchants 42
Stand alone locking device 28
locking device 28
tel. i/f 32
rf i/f 34
n/w i/f 36

Fig. 3

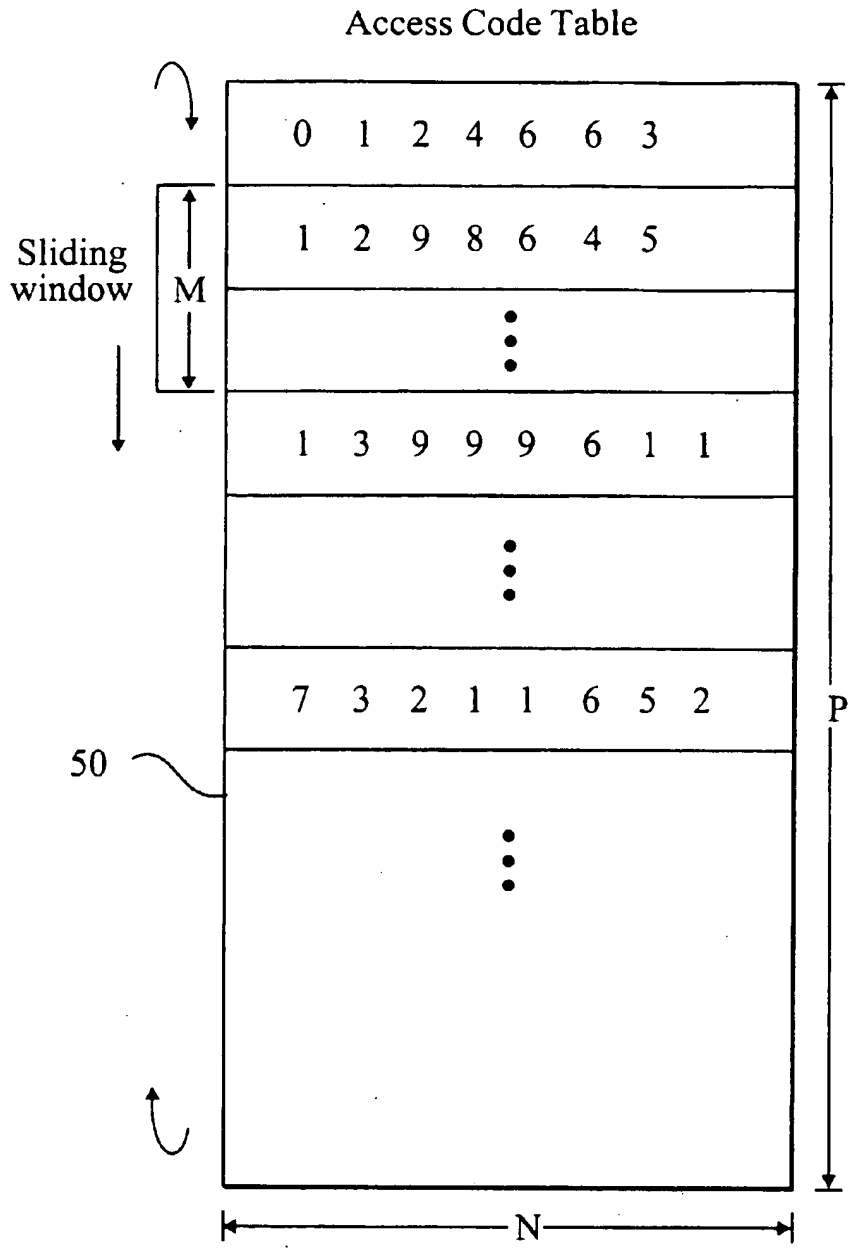

Access Code Table
0 1 2 4 6 6 3
1 2 9 8 6 4 5
Sliding window
M
1 3 9 9 9 6 1 1
7 3 2 1 1 6 5 2
P
50
N

Fig. 4

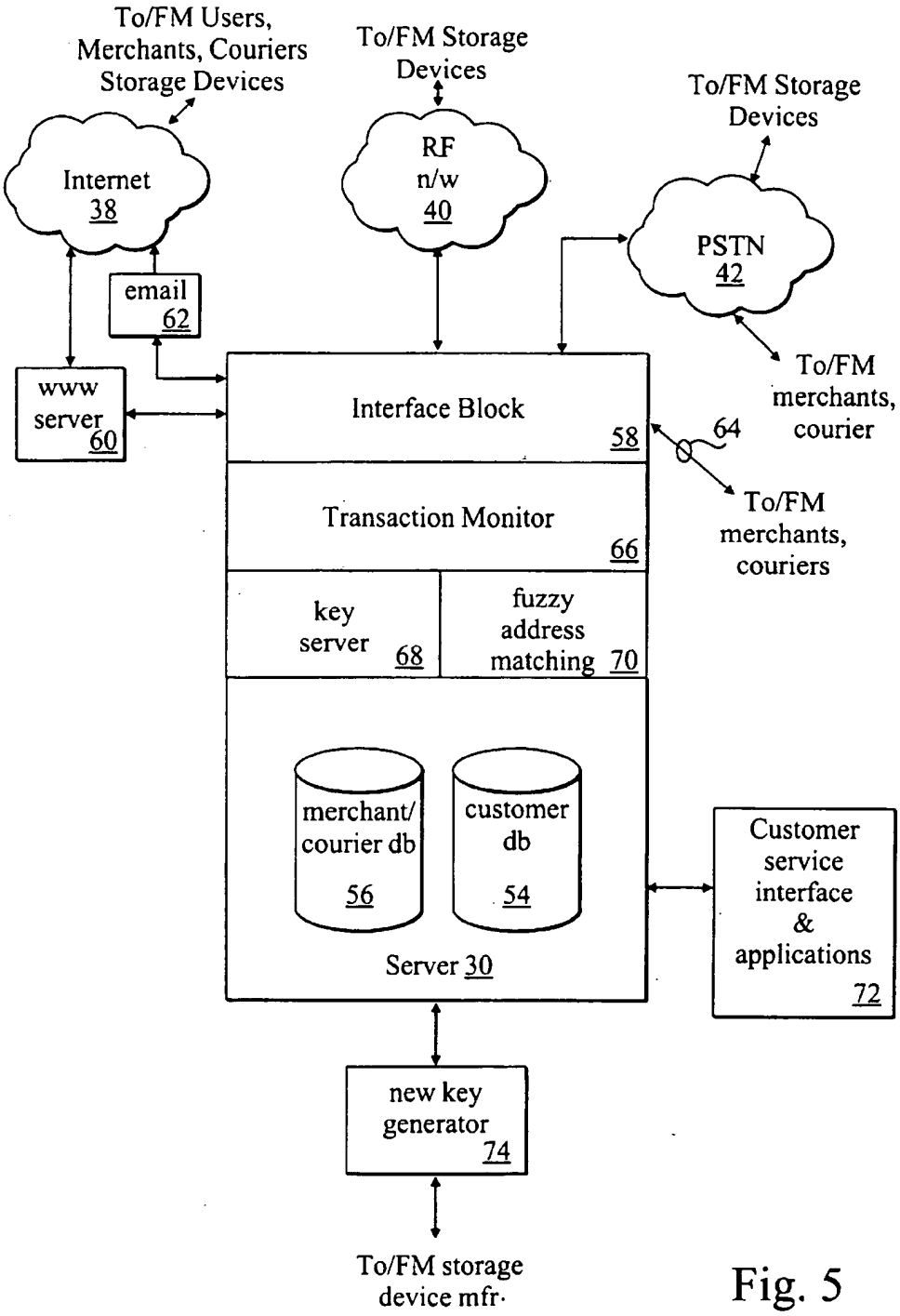

To/FM Users, Merchants, Couriers Storage Devices
To/FM Storage Devices
To/FM Storage Devices
Internet 38
RF n/w 40
PSTN 42
email 62
www server 60
Interface Block 58
64
To/FM merchants, courier
To/FM merchants, couriers
Transaction Monitor 66
key server 68
fuzzy address matching 70
merchant/ courier db 56
customer db 54
Server 30
Customer service interface & applications 72
new key generator 74
To/FM storage device mfr.

Fig. 5

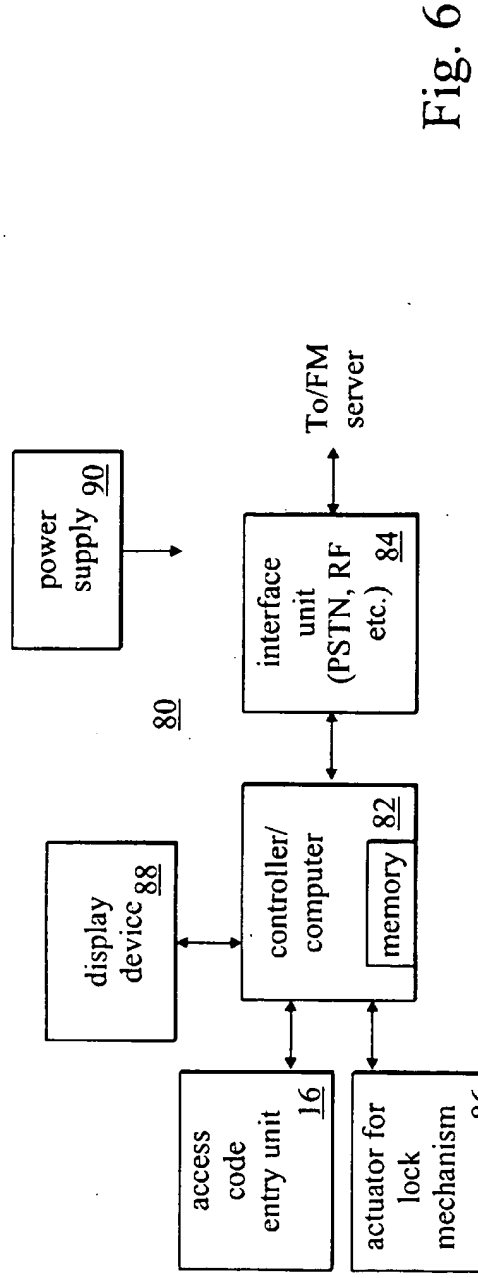

power supply 90
To/FM server
interface unit (PSTN, RF etc.) 84
80
display device 88
controller/ computer
memory 82
access code entry unit 16
actuator for lock mechanism 86

Fig. 6

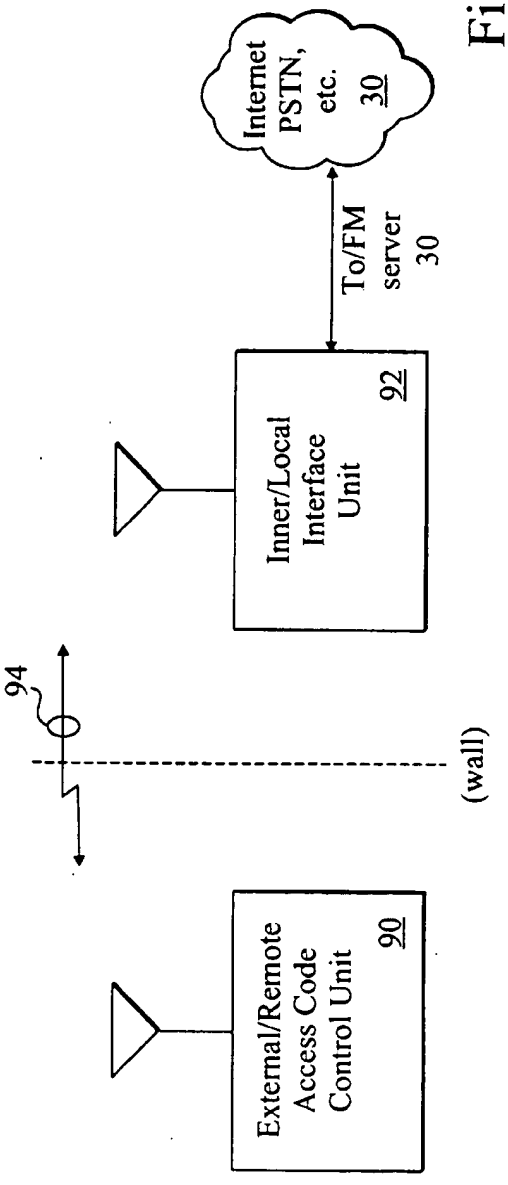

Internet PSTN, etc. 30
To/FM server 30
Inner/Local Interface Unit 92
94
(wall)
External/Remote Access Code Control Unit 90

Fig. 7

# LOCKING MECHANISM FOR USE WITH ONE-TIME ACCESS CODE

## RELATED APPLICATION

This application is related to and hereby claims the priority benefit of a Provisional Application entitled "A System for Secure Unattended Delivery and Pickup of Goods", application Ser. No. 60/154,294, filed Sep. 16, 1999, by the present inventors.

## FIELD OF THE INVENTION

The present invention relates to a scheme for providing one-time use access codes for a lock mechanism as may be employed with secured doors to and/or from buildings, secured access points and/or containers, etc., including secure storage devices for the delivery and pickup of goods and/or other applications/appliances/mechanisms that require security.

## BACKGROUND

U.S. Pat. No. 5,774,053, which is hereby incorporated by reference, describes a storage device for the delivery and pickup of goods. As recognized in that disclosure, home delivery of goods has become more and more popular with the rise of shopping over the Internet, by catalog, and so on. In addition to clothing, appliances, furniture, books and other materials previously available from catalogs and the like, the Internet has spawned e-shopping services for groceries and other items. Similarly, in many areas local merchants such as dry cleaners offer residential pickup and delivery services for their customers.

The storage device described in U.S. Pat. No. 5,774,053 provided a means for such home pickups and deliveries even when the homeowner was absent. Briefly, the storage device provided a secure environment for the goods and included a communication apparatus for providing notification that the goods had been picked up or delivered. Access to the storage device was gained by entering a so-called vendor code into a controller via a keypad. The controller oversees locking/unlocking of the storage device. Entering a valid vendor code unlocks the storage device, allowing couriers and/or others to pickup and/or deliver goods from/to the storage device.

One shortcoming with the storage device described by U.S. Pat. No. 5,774,053 concerns the use of the vendor codes. As contemplated, the vendor codes are static, reusable codes assigned to each vendor that delivers and/or picks up goods to/from the storage device. "For example, a laundry and drycleaning (sic) business may be assigned a vendor code of 333, whereas a local grocery store may be assigned a vendor code of 444." U.S. Pat. No. 5,774,053 at col. 5, ll. 39–45. The use of such vendor codes presents a security risk in that once an unauthorized person learns one of the codes, that individual has access to the storage device until such time as the code is removed from the list of authorized vendor codes stored in the controller's memory. This presents a problem inasmuch as several days or weeks may pass before a storage box owners learns that one or more of the vendor codes has been compromised and has time to reprogram the controller with new vendor codes. During this time, the security of the storage box is questionable at best. Moreover, the assigning, canceling and reassigning of the vendor codes requires what could be a significant amount of time and effort (key management) on the part of a storage device owner/end-user. Also, the vendors are required to keep track of codes for different customers and, presumably, must take steps to ensure that the security of these codes are maintained.



## SUMMARY OF THE INVENTION

Described herein is a scheme for providing locking mechanisms (that may be used in a variety of applications) for use with one-time access codes. The present scheme avoids the drawbacks of the system described above, for example by providing a third-party service that handles key management. The third-party service may issue access codes to vendors, etc., for one-time use and thereby free the storage device owners from having to perform and manage this task. Also, because the access codes are intended for one-time use only, vendors and others are freed from the responsibility of maintaining the security of a number of keys for different customers for indefinite periods. Keys (or access codes) may be distributed to the locking mechanism in a variety of ways (including via a RF network and/or at the time of manufacture).

In one embodiment, a request for an access code for a locking mechanism is received; and a one-time use access code for the locking mechanism is subsequently issued. The one-time use access code may be issued from a list of currently available access codes for the locking mechanism in response to a request therefor, for example by a merchant or delivery service. Such a code may be issued by a server, which server is further responsible for updating the list of available access codes in response to an indication that a code has been issued, used or has otherwise expired. The list of currently available access codes is preferably a subset of all access codes for the locking mechanism, which codes may be generated using a cryptographically strong random number generator. Such a locking mechanism may be used with a storage device, a door or gate, or any appliance or other mechanism or may find application in a variety of security systems.

In a further embodiment, a storage device that includes an enclosure adapted to allow for the storage of goods and having a door fitted with a locking mechanism; and a locking mechanism controller coupled to the locking mechanism and adapted to unlock the locking mechanism upon receipt of an entry code, said entry code expiring within a first predetermined time interval of its first use to unlock the locking mechanism (which may include some time after the locking mechanism has been re-locked), is provided. The entry code may expire within a second predetermined time interval (or, in other cases, a time window that varies, e.g., according to past usage of the locking mechanism) regardless of whether it is used to unlock the locking mechanism or not. The locking mechanism controller preferably includes a microcontroller configured to operate an actuator in response to receiving the entry code and may be adapted to receive the entry code via at least one of a keypad, a bar code scanner, a magnetic stripe reader, a wireless (e.g., RF or IR receiver) or a smart card reader. In some cases, the locking mechanism controller may be configured to communicate with a server (e.g., via at least one of the Internet, a wireless network or the public switched telephone network) configured to provide the entry code.

In a further embodiment, a computer-based service configured to dispense one-time use access codes for remotely located locking devices in response to requests therefor is provided. Transaction fees may be assessed for each access code dispensed and the access codes may be so dispensed from a server accessible through at least one of the Internet,

a wireless network or the public switched telephone network. Preferably, each access code so dispensed expires upon the earlier occurrence of (i) its use to access an associated one of the storage devices, or (ii) a predetermined time period.

These and other features and advantages of the present invention are discussed in detail below.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example, and not limitation, in the figures of the accompanying drawings in which like reference numerals refer to similar elements and in which:

FIG. **1** illustrates an example of a storage device configured in accordance with an embodiment of the present invention;

FIG. **2** illustrates top, front and side views of the storage device shown in FIG. **1**;

FIG. **3** illustrates a computer network configured to accept requests for and issue access codes for storage devices similar to that shown in FIG. **1**;

FIG. **4** illustrates an example of an access code table that may be maintained within a server and/or a storage device in accordance with an embodiment of the present invention;

FIG. **5** illustrates a more detailed view of a server suitable for use with the network shown in FIG. **3**;

FIG. **6** illustrates an example of a locking mechanism controller for the storage device shown in FIG. **1**; and

FIG. **7** illustrates an example of the use of a local interface unit as a relay station for messages passed between a remote access code control unit and a server.

## DETAILED DESCRIPTION

A locking mechanism adapted for use with one-time use access codes (and schemes for requesting/delivering such codes) as well as their use with various storage devices are described below. Although discussed with reference to certain illustrated embodiments, upon review of this specification, those of ordinary skill in the art will recognize that the present invention may find application in a variety of systems. Therefore, in the following description the illustrated embodiments should be regarded as exemplary only and should not be deemed to be limiting in scope.

In one embodiment, the present system allows for the secure delivery and/or pickup of goods, thereby increasing the efficiency of courier personnel by providing means for unattended pickup/delivery. In addition, means for verifying such delivery/pickup are incorporated within the system. One embodiment of the present system is composed of storage devices (adapted to be placed at locations where pickup/delivery services are desired, e.g., residences, office buildings, condominium and/or apartment developments, etc.), one or more computer servers, communications devices, human interface components and software. Features of the system include package tracking, electronic signatures, payment transfer, delivery scheduling, unattended transfer/storage of parcels and event notification to multiple parties. In addition, the present system allows for confirmation of deliveries/access to the storage device as well as confirmation of acceptance of the items delivered. As will be more fully described below, a unique one-time access code to allow access to a locking mechanism associated with a storage device is issued by a server for each access, pickup or delivery, thus reducing opportunities for theft and/or tampering and providing for the tracking of each access.

The present scheme also allows for goods and other materials to be picked up and delivered in a secure, traceable fashion. Physical security is provided in part by securing the storage device at the customer premises. This can be accomplished by fixing the storage device to the site with bolts or other fastening devices passed through reinforced points inside the body of the storage device and attaching same to a wall or floor. Alternatively or in addition, a water bladder/tank inside the storage device may be filled to add weight (and thus discourage unauthorized persons from attempting to move the storage device) and also acts to stabilize the temperature inside the storage device during the course of the day. The tank walls may be positioned several inches from the exterior of the storage device, thus preventing draining of the tank by puncturing the exterior of the storage device. In addition, a cable or chain may be used to secure the storage device at the site via an attachment point.

An example of such a storage device fitted with a locking mechanism configured in accordance with the present invention is illustrated in FIG. **1**. Storage device **10** has a generally rectangular base and is of a size sufficient to hold the type of goods that can be expected to be delivered. For example, storage device **10** may be of sufficient size to receive a delivery from a grocery store and/or other goods and/or the maximum or expected size of common courier deliveries. In the example shown in the figure, storage device **10** has a sloping lid **12** that extends from the rear of the storage device to the front thereof and which is hinged so as to open upwards and to the rear, but other embodiments of storage device **10** may be fitted with a door that opens to the side, front, bottom or top. A handle **14** is provided for user convenience in opening the lid **12**, but other opening mechanisms (e.g., knobs, recessed handholds, etc.) may also be used. The physical design/size of storage device **10** is not critical to the present invention.

As shown, storage device **10** is configured with a locking mechanism that may be activated/deactivated via an access code entry unit **16**. In one embodiment, access code entry unit **16** includes a keypad and display (useful for displaying messages such as the time and/or date of the last access and/or the identity of the person making such access based on the code used, etc.), and is configured to accept user input in the form of keystrokes and to provide user feedback and other human interface elements via a liquid crystal or other display. In other embodiments, the access code entry unit may operate in conjunction with an infrared transmitter (similar to an automobile keyless entry system), a barcode scanner and/or a magnetic stripe or electronic card reader. The infrared transmitter may be used by the owner of the storage device **10** to gain entry to the storage device without the need to manually enter an access code. In such cases, the infrared transmitter may be configured to emit a coded message upon activation, which message serves to authenticate the user and cause the access code entry unit (fitted with a corresponding infrared receiver) to unlock the locking mechanism. Similarly, a card with a magnetic stripe (coded with the user's access code) may be used to open the storage device **10**, where the access code entry unit **16** is fitted with a magnetic stripe reader. An electronic card (e.g., fitted with a smart chip or other means of transmitting an access code) may also be used in place of or in addition to these other access means. Indeed, any or all of these access means may be employed in combination.

One other access means concerns the use of bar code scanners. A bar code is a combination of black and white lines that contains character information. The character information in bar codes may be read with specialized

reading devices and subsequently passed on to a computer or other device (e.g., cash registers and other appliances). Various types of reading devices are used to obtain the data represented in bar codes, depending upon the application. One type of reading device that is used is a scanner. Scanners are generally equipped with laser diodes and a system of mirrors and lenses to scan the bar code and capture the reflection thereof. Other bar code reading devices that operate on similar principles include gun readers, light pens, cameras, etc.

In one embodiment, a specially configured bar code scanner (or other bar code reader) is adapted to modulate the laser beam produced by its laser diode, so as to transmit an access code. A bar code entry unit is positioned on storage device **10** (e.g., in place of or in addition to access code entry unit **16**) and is configured to pass the access code information included in the modulated laser beam to a computer/controller unit of the access code entry unit. In this way, access code information may be passed to the storage unit at the same time as bar code information (e.g., a serial number or the like) is read therefrom.

FIG. **2** illustrates front, side and top views of the storage device **10**, with certain features thereof not illustrated so as not to unnecessarily obscure other features of interest in the following discussion. Shown in broken line outline is the tank **18**, which is located at the bottom of the interior portion of storage device **10** and which can be filled with water, sand or other material or fluid as described above. Also shown in broken line outline is an inner security compartment **20**, which is located inside and secured to storage device **10**. The inner security compartment **20** provides a secure "box within a box", and may be opened using a separate access control mechanism which opens storage device **10**. For example, inner security compartment **20** may be fitted with a conventional key lock, a pad lock, combination lock or an electronic locking mechanism that relies on access codes similar to that described below. Inner security compartment **20** provides a storage space for highly confidential and/or valuable materials (such as cash, jewelry, cameras, etc.). Owners of storage device **10** may use inner security compartment **20** as a secure holding place for cash or other payments for COD delivery items and/or to receive delivery of valuable materials which others should not have access to. For example, if the owner is expecting multiple deliveries on the same day, one of which requires a COD payment, the owner may leave the payment funds locked within the inner security compartment **20** and provide the means for gaining entry to that inner security compartment (e.g., the lock combination or electronic access code, etc.) only to the delivery person expected to make the COD delivery. Other delivery persons will not have access to the inner security compartment **20**, because the access code for storage device **10** will not operate the locking mechanism for the inner security compartment. In this way, the owner can ensure that only the desired delivery person (or other courier, neighbor, etc.) can have access to the contents of the inner security compartment **20**.

Storage device **10** also includes an electronic component bay **22**, which may house the various electronic components of the locking mechanism described below. The power source (e.g., battery) for these components may also be located herein, and/or an external battery clip **24** may be provided. Preferably, the external battery clip **24** is only used to connect an external battery when the primary power source for storage device **10** has failed. In such situations, it is desirable that the power failure mode of the locking mechanism is the locked state. That way, in the event of a power (e.g., internal battery) failure, the storage device remain locked, until an external battery is applied to the battery clip **24** and the proper access code entered. Although this may cause one or more delivery attempts to fail, it is deemed to be preferable to a situation where the storage device fails over to an unlocked state. The same electronics bay **22** may include electronic circuitry and/or power sources for the inner storage compartment **20**, or such electronics and/or power sources may be separate.

In one embodiment, the interior of storage device **10** includes a bar code unit **26** (shown in the side view only for clarity). The bar code unit **26** (which in some case may simply be a label glued or otherwise applied to the interior of the storage device **10** or in other cases may be a more durable bar code unit supported by a holder) provides a serial number or other identifying criteria for the storage unit **10**. Thus, when delivery personnel that require some form of signature for dropping off a delivery leave a package in storage device **10**, the bar code embossed on the bar code unit **26** can be read (e.g., using a conventional bar code scanner or other reader device) as a form of "digital signature". In some cases, the signature information may later be downloaded from the delivery service to the access code service provider (as described below) to confirm delivery and to acknowledge use of the access code.

FIG. **3** illustrates an embodiment of the present invention wherein a server (accessible through a number of means) is responsible for providing delivery personnel, merchants, customers and others with access codes for storage devices **10**. Server **30** may be operated by a service provider that licenses, sells, leases, or otherwise provides locking devices **28** (e.g., for use with storage devices **10** or for other applications) to users thereof. As shown, locking devices **28** may be configured in a variety of ways: as stand-alone devices, or as connected devices, which communicate with server **30** via telephone interfaces **32**, wireless (RF) interfaces **34** and/or network interfaces **36**. The network interfaces **36** may be dedicated or dial up interfaces/connections that utilize a public computer network (such as the Internet **38**) or a private computer network (such as a wide area network or virtual private network that tunnels within a public network). The RF interfaces may support communication within a public (e.g., cellular) or private wireless network **40**. Telephone interfaces **32** may be adapted to provide communication with server **30** through the public switched telephone network (PSTN) **42** (e.g., via dial-up modem connection or Internet connection via Digital Subscriber Line, cable/wireless modem, etc.). Corresponding interfaces are provided at server **30** to allow for bidirectional, full-duplex and/or half-duplex communication with the locking devices **28**.

Server **30** may also be accessed by various merchants **42**, couriers/delivery services **44** and/or customer **46** through the Internet **38** or other means. For example, in some cases, one or more merchants **42** and/or couriers/delivery services **44** may maintain dedicated connections with server **30** through one or more dedicated interfaces **48**. Thus, delivery services that experience a significant amount of interaction with owners of the storage boxes **10** may utilize such dedicated connections to request and receive access codes for locking devices **28** associated therewith, without having to establish individual connections through the Internet **38** for each transaction.

As alluded to above, one of the functions of server **30** is to provide access codes for the locking devices **28**. In operation, owners (and herein the term owners is meant to encompass lessees, owners and others who have a locking

device **28**) of locking devices **28** will be able to instruct a delivery service, merchant, courier or other person or entity that any deliveries/pick ups for the owner should be made to/from the owner's storage device **10** that is configured with a locking device **28**. For example, when shopping through an Internet based merchant, when it comes time for the owner to indicate his/her delivery address, he/she may indicate the serial number or physical address (which need not necessarily be the owner's home address) of the storage box **10**. By identifying the existence of the storage box in some way, the owner is prompting the merchant (or delivery service used by the merchant, etc.) to request an access code from server **30**. The retrieval of such an access code may be completed as part of the checkout process from the Internet-based store, or it may be performed as a post-transaction function when the merchant behind the store processes the transaction. In other cases, when the storage box owner is expecting a delivery from a local merchant (e.g., a dry cleaning service or grocery delivery service, etc.), he/she may instruct the local merchant to request an access code from server **30** in order to deliver the goods to the storage box **10**.

Regardless of how the delivery service/merchant is advised to request an access code, that delivery service/merchant may access server **30** (either via the Internet **38** or through a dedicated connection, etc.) and request an access code by providing some identifying information about the subject locking device (and/or associated storage device, e.g., a serial number, owner's name and/or address, etc.). Recall that the access codes are meant to be one-time codes. That is, the codes are good for only one access to the locking device **28**. Thus, every access code issued by server **30** for a particular locking device **28**, will be unique to the requester. That requester, and only that requester, will know the access code, and that access code will expire after it is used to open the subject locking device **28** (with reuse possible within a certain, short time interval in some cases). Therefore, not only does this minimize the risk of unauthorized access using an access code (because even if the once valid code were to be compromised it cannot be reused), it also allows tracking of which individuals/entities had valid access codes at a particular point in time.

The one-time access codes may be provided through the use of code books that are personalized for each locking device. For example, at the time each locking device (or its access code entry unit) is manufactured, a number of access codes may be stored in memory in a particular sequence. For example, the access codes may be stored in a table, similar to that shown in FIG. **4**. Each access code may be N-digits long (e.g., 4–10 digits and in one embodiment 5–7 digits) and up to P (e.g., 1024–2048 or more) such access codes may be stored in a table **50** resident in memory (see below for a more detailed discussion of the access controller). These codes may be generated by a cryptographically strong random (e.g., pseudo-random) number (using a unique seed number for each individual locking device) generator at the time of manufacture and a replica of the access code table **50** for each locking device may be maintained at server **30** (e.g., as part of a customer database and/or a key database). Each time a delivery service, merchant and/or other person/entity requests an access code for a particular locking device, an unused code from the table for that locking device is selected and provided to the requester (preferably only after authenticating the identity of the requestor through the use of a previously assigned pass-code or the like).

In one embodiment, access codes for a locking device **28** are issued sequentially, and a new access code is not issued until the previously issued access code has been used. An indication of such use may be provided by communication between the locking device **28** and the server **30** (e.g., using one of the communication links discussed above) and/or by an indication from the delivery service/merchant/courier that the delivery/pick up has been completed. Also, the locking device owner may be responsible for providing an update to the server **30** indicating that a delivery or pick up was completed.

The sequential use of access codes in the manner discussed above provides very precise control over the access codes in as much as only one code is outstanding at any one time. However, it may be inconvenient inasmuch as a storage device owner may wish to receive several deliveries and/or schedule pick-ups that overlap with one another. To accommodate such situations, in another embodiment a number of access codes within a certain window of size M<<P may be issued, where the window need not necessarily include consecutive access codes. That is, to accommodate the need to issue multiple access codes within any given time frame, a window of size M is established. As requests for access codes are received, those access codes within window M are issued (e.g., sequentially, in round robin fashion, or in another fashion). As the access codes that have been issued are used and the server **30** is subsequently notified of such use, the window slides or is otherwise moved so as to indicate that the used code(s) has/have expired and to include new access codes. In other embodiments, the server **30** need not be notified of the access code use, rather such window movement may be based on time intervals, etc. In this way, the problem of overlapping deliveries/pick ups is rendered moot.

The size of the window may be configured by the storage box owner to accommodate his/her expected delivery/pick up frequency and can be altered at any time to account for especially busy times (such as near the holidays or prior to a special occasion when multiple deliveries can be expected). Alternatively, or in addition, the window size may be adjusted automatically based on use of the locking device. It is important, however, that the window sizes at the locking device **28** and server **30** be synchronized so that valid access codes are not rejected. So long as P is large enough, there should be sufficient time between reuse of any access codes so as to minimize the risk of compromise. Alternatively, once all the available access codes have been used, the locking device **28** may be reinitialized with a new set of access codes or the codes may simply be recycled (perhaps not in their original order of issue).

To account for situations where some codes are never used (e.g., cancelled deliveries and/or pickups), server **30** and locking device **28** can be configured to automatically cancel a particular access code after it has existed for some period of time (e.g., a few days or weeks or even just hours if so desired) within the window of valid codes. This use of a "time to live" for each access code prevents the window from becoming clogged with out-of-date codes that will never be used.

In still another embodiment, rather than having a table of available access codes, each locking device may be configured with a cryptographically strong random number generator as part of its access code entry unit. The numbers produced by the random number generator (with each new number so produced being used as a new seed number) may then be used as the access codes for that locking device. In such cases, server **30** would be configured with a similar random number generator and some knowledge of what a particular locking device's original seed number was. By

knowing the seed number and the number of times the locking device has been accessed (e.g., the number of access codes given out), the server can predict what the next random number in the sequence produced by the random number generator at the locking device will be. This number can then be issued as the next access code for a requestor. Note that this scheme may present some of the problems discussed above for the overlapping delivery/pick up scenario, but may be suitable where the chance of such occurrences is small. To avoid such problems altogether (or at least to a greater degree), several (i.e., a window's worth) of access codes may be generated at a time and issued as needed. Of course, the corresponding access code entry unit would need to do the same so that codes within the window would be recognized.

Yet another way of distributing access codes is to use the server **30** to "push" such codes to the locking device **28**. For example, a delivery service may already use unique tracking or other numbers for packages that are being delivered. Such tracking or other numbers could serve as access codes for the locking device where the delivery service notifies the server **30** of the tracking number and then server **30** transmits the tracking number to the locking device using one of the communication paths discussed above. The locking device **28** (or its associated access unit) may then store the tracking number in memory and allow its one-time use as a valid access code. Of course, such a scheme need not be limited to tracking numbers and any user-supplied access code could be used. Note that security precautions (such as password challenges, etc.) may need to be taken to ensure that such access codes are being provided by trusted sources. In this way, even user/owner PIN numbers could be uploaded to the locking devices.

Also, locking device owners may be able to notify server **30** of a valid access code be having the locking device itself upload the code to the server **30** through one of the above communication paths. The owner may set the code using the keypad or other interface associated with the access control unit and this code may then be supplied to server **30**. Thus, the user may be able to provide an access code for an individual that does not have access to server **30**. The idea of notifying server **30** of the user-specified code is to ensure that such code is not then reissued any time soon, so as to maintain the security of the locking device.

To this point, the use of server **30** as a means for requesting/delivering access codes has been discussed. Server **30** is also capable of operating as a central point of information dispersal. For example, storage device owners may be able to notify merchants and/or couriers that items are available for pick up through the use of server **30**. By accessing server **30** (e.g., through the Internet or even by simply pressing a button or other notification mechanism at the storage device/access code entry unit), the owner may be able to complete a Web form (or send another notification message) that requests pick up of a specified item or items at a certain date/time and upon submission of that Web form server **30** may transmit an electronic mail (e-mail) message to the designated courier/merchant along with the necessary access codes.

The role of server **30** as an information aggregator is more fully discussed with reference to FIG. **5** (of course this is merely one example of a server architecture and many other variants thereof may be used). As shown, server **30** is configured with one or more databases, for example a customer database **54** and/or a merchant/courier database **56**. An interface block **58** provides the interfaces for server **30** to the Internet **38** (e.g., via a Web server **60** and/or an e-mail engine **62**), an RF network (e.g., a cellular or packet radio network) **40** and/or the PSTN **42**. Direct connections **64** with merchants/couriers may also be accommodated through interface block **58**.

A transaction monitor **66** is responsible for keeping track of incoming access code requests, verifying requesters (e.g., by comparing offered pass-codes with those stored in the customer and/or merchant courier databases), issuing access codes, receiving reports of used access codes and updating access code table information. The access code tables (where used) may be stored as part of customer database **54** and accessed through a key server **68** which is responsible for receiving and acknowledging access code requests (with or without the assistance of the transaction monitor **66**). A fuzzy address matching block (e.g., algorithm) **70** may be provided to accommodate misspellings or other typographical errors when access code requests, etc. are made. For example, where an address is entered that has no corresponding match in the customer database **54**, the fuzzy address matching block **70** may be configured to run alternate queries with slightly different spellings of the submitted address to see if any matches are found. If such matches are found, server **30** may respond with a question such as "Did you mean . . . ?" In this way, merchants and other seeking access codes for their clients' storage devices will not be turned away blindly, perhaps causing missed deliveries or general customer dissatisfaction with the service.

A customer service interface and application block **72** may be provided to allow new customers to sign up and request delivery of locking devices and/or update their address information, etc. This also provides a data entry interface for various merchants/couriers, etc. that want to enter/update their information in the relevant databases. Further, this may include applications that allow for remote programming of the access code entry unit and/or locking device so that keypad features thereof may be updated/modified.

Another component associated with server **30** is the new key generation block **74**. In this block (which may be a software component of server **30** or a dedicated computer system), the access code tables for new storage devices may be generated and copies thereof provided to the server **30** (e.g., for inclusion in the customer database **54**) and/or the storage device fabrication facility (e.g., for inclusion within the new storage devices). Matching of storage device serial number (or other identifying criteria) and access code table is important otherwise it may not be possible to gain entry to a storage device.

FIG. **6** now illustrates an example of an access code controller **80** for a locking device **28**, portions of which may be housed in the electronics bay **22** of storage device **10** described above. A central component of the access code controller **80** is a micro-controller/computer **82**. In some embodiments, this micro-controller/computer may be a general-purpose microprocessor with associated volatile and non-volatile memory. The non-volatile memory may be programmed with an operating system and various subroutines for the microprocessor to provide the needed functionality and may also store the access code table for the locking device where such a table is used. An interface unit **84** may be provided for intercommunication with server **30** (where the storage device operates in other than a stand-alone mode) and this interface unit may allow for communication via the Internet, the PSTN and/or an RF or other network. This interface unit may also be configured to accept access codes from an owner-operated remote control as described above.

The micro-controller/computer **82** is configured to accept inputs (e.g., access codes) from the access code entry unit **16**. As indicated above, these codes may be provided in a variety of formats, such as keystrokes from a keypad, magnetic stripe reader and/or bar code scanner. Other access code entry devices may also be used. Upon entry of an access code, the micro-controller/computer may be programmed to compare the entered code with the available valid codes and, upon successful comparison issue a control signal to an actuator **86** to unlock the storage device. If the entered code does not match a valid code, a failure message may be displayed on a display device **88** (e.g., a liquid crystal or other display, which, in some cases, may be part of the access code entry unit **16**). Where several failed attempts (e.g., **3**) to gain access to the storage device occur in succession, the micro-controller/computer may be programmed to reject any further attempt to open the storage device until the owner enters a special reset or other code. In such cases, the micro-controller/computer may also be configured to report such attempted access to the server **30** for further investigation. Other deterrence mechanisms include prolonging the lock-out period between repeated access attempts.

A power supply **90** (e.g., a battery or some other power supply) is provided to power the electronic elements of access controller **80**. As discussed above, means can be provided for alternate power supplies in the event of a power failure.

Storage device **10** and the one-time access-code scheme described above provide for some interesting business opportunities for the provider operating server **30** (hereinafter referred to as the "service provider"). For example, unlike the scheme described in U.S. Pat. No. 5,774,053, the present service provider is and remains part of the chain of commerce in every pick up and/or delivery from/to a storage box **10**. This is an opportunity to realize revenue from the distribution of access codes, rather than merely from the distribution of storage devices. Because one can expect to distribute may more access codes than storage devices, it follows that the potential overall revenue to be realized from the present business model is greater than that which may be realized simply from distributing storage devices.

In addition, the service provider has the opportunity to act as a virtual escrow agent. Because the service provider can track the delivery of goods to the storage device (e.g., through the reporting back of the use of an access code in the fashion described above), the service provider can withhold payments to a merchant or other third party until such delivery can be confirmed. This is especially attractive in the area of Internet-based auction transactions, where both seller and buyer are reluctant to be the first to transmit goods or money as the case may be. By arranging for payment and delivery through the service provider (e.g., following the conclusion of an auction), each party is assured that funds will be transmitted upon delivery and not before (although the service provider cannot assure any quality of the goods so delivered).

Because the use of the storage device provides security, delivery services need not schedule deliveries around a customer's physical presence. Indeed, modified storage devices that are configured to provide refrigerated or heated compartments may be used so that perishables and other temperature-sensitive items may be delivered at any time into the storage box. This added convenience for the delivery service providers might be an incentive for such businesses to offer similar payment mechanisms through the present service provider as a way of attracting new customers. The present service provider benefits by experiencing an increase in the number of access codes issued (presumably at a fee) for an increasing number of deployed storage devices.

Although the foregoing description and accompanying figures discuss and illustrate specific embodiments, it should be appreciated that the present invention has much broader applicability. For example, the locking device may be used with doors, gates (e.g., providing access to gated communities, condominium developments, apartment complexes, etc.) and other security systems. Such broader applications are all within the scope of the present invention. In addition, the storage device described above may be adapted for use as a secure mailbox by providing a mail delivery slot through a side or top of the storage device (similar to such delivery slots as may be found on the door of a house or building). Indeed, the storage device could be adapted to receive mail into the secure box within a box, so that delivery personal would not have access to the mail so delivered. Of course a conventional (or secure) mailbox could simply be attached to the exterior of another storage device.

Still other variations of the above-described scheme are possible. For example, the access codes themselves could be the tracking numbers (or other identifying criteria) assigned by the delivery service or merchant. Consider, for example, a situation where a storage device owner purchases certain goods form an on-line store and requests delivery. When the on-line merchant arranges for delivery of the goods, for example through a commercial delivery service, a tracking number for the package(s) is usually assigned. Either the merchant or the delivery service may than notify the server **30** of this tracking number and the server **30** may communicate (e.g., via the internet or through a wireless and/or wired link) with the access code controller **80** to inform the controller **80** that such tracking number is a valid access code. The controller **80** may store the tracking number in memory for later recall/comparison. Note, the storage device **10** may even be fitted with a bar code reader/scanner to allow a delivery person to scan in the tracking number from a bar code applied to the package being delivered, thus avoiding the need to manually enter the tracking number/access code.

Communication between the server **30** and the controller **80** may be accomplished in any of the above-described fashions or as follows. As shown in FIG. **7**, one embodiment of the present invention provides an external/remote access code control unit **90** and an inner/local interface unit **92**, which communicate with one another via a wireless (or in some cases a wired) communication link **94**. The remote access code control unit **90** may be located some distance away from the local interface unit **92** and/or may be on the opposite side of one or more obstructions (e.g., a wall) therefrom. In one case, the remote access code control unit **90** may be co-located with a storage device outside a home, while the local interface unit **92** is located inside the home (e.g., near a telephone jack or connected to a personal computer or other appliance having an Internet connection).

In operation, messages to be passed between server **30** and remote access code control unit **90** may be relayed through local interface unit **92**. For example, interface unit **92** may communicate with server **30** through a conventional Internet/PSTN connection (e.g., using a modem unit, etc.) and with remote access code control unit **90** through wireless (e.g., RF or IR) connection. Messages from remote access code control unit **90** may be downconverted,

decoded, translated and/or packetized (e.g., according to conventional TCP/IP or other communication protocols) for transmission to server **30**. Likewise, messages from server **30** may be depacketized, decoded, translated and/or upconverted for transmission to remote access code control unit **90** across communication link **94**. Such a mechanism allows for the exchange of many different types of messages between the server **30** and the remote access code control unit **90**, such as access codes, instructions to change window sizes, delivery/acceptance notifications, pick-up requests, payment authorization messages, etc.

In some cases, the local interfaces unit **92** may be configured with a notification unit to alert users that packages/goods have been delivered and/or picked up from a storage device associated with the remote access code control unit **90**. For example, such a notification unit may be a conventional liquid crystal display, one or more light emitting diodes, and/or other indicators that signal the pick-up/delivery of items. The interface unit **92** may also be equipped with a keyboard or other man-machine interface to allow for user communication with server **30**, for example to indicate that items are available for pick-up or to request/set access codes, etc.

Returning now to FIG. **6**, in some configurations of access code entry unit **80**, the access code entry unit **16** may include means for accepting a biometric identification. Thus, finger/thumb print recognition units, retina recognition units, signature capture mechanisms (e.g., as are commonly used at point-of-sale terminals), and/or other means may be employed as access devices for the unit. In this way, users need not necessarily have to remember personal identification numbers (PINs) and/or use other remote access devices. Further, the access code entry unit **16** and/or controller **80** may be configured to accept special access codes to allow users to change their PIN, reset a window size and/or switch access code tables, and perform other customization/maintenance routines. Once such customization routine may be used to designate certain buttons of the access code entry unit **16** as specific function keys. For example, one or more keys may be designated to transmit messages to specific vendors/couriers (e.g., via e-mail or other messages through server **30**), indicating that packages, etc. are ready for pick-up.

As mentioned briefly above, one of the advantages provided by the present invention concerns confirmation of delivery. Upon access by the delivery person, the controller **80** can be programmed to transmit a message to server **30** (e.g., using one of the above-described communication channels) that includes the access code used by the delivery person. Server **30** can compare this access code to those previously issued and (in addition to updating any code windows, etc.) can then relay a message (e.g., via e-mail, pager, facsimile or other means) to the storage device owner that not only indicates that a delivery has been made, but who/which organization made the delivery. In addition, upon user access to the storage device, similar notice can be given to server **30** and server **30** can, in turn, send confirmation of receipt messages to any vendors/delivery services that had deposited packages in the storage device. This may be especially useful where the delivery service requires or relies upon a customer "signature" and the confirmation of receipt message can be used as a virtual signature or can even include a digital representation of the customer's actual signature for record keeping purposes.

Given the breadth of applications and variations for the above-described schemes then, the present invention should not be limited by the above-described examples but rather only measured in terms of the claims, which follows.

What is claimed is:

**1**. A method comprising:

receiving at a server and via the Internet a request for an access code for a locking mechanism; and

issuing from the server a one-time use access code for the locking mechanism, wherein the one-time use access code is issued from a list of currently available access codes for the locking mechanism.

**2**. The method of claim **1** wherein the one-time use access code is issued in response to a request received from a merchant or delivery service.

**3**. The method of claim **1** further comprising updating the list of available access codes in response to an indication that a code has been issued or used.

**4**. The method of claim **1** further comprising updating the list of available access codes in response to an indication that a code has expired.

**5**. The method of claim **1** wherein the list of currently available access codes is a subset of access codes for the locking mechanism.

**6**. The method of claim **5** wherein the access codes for the locking mechanism are generated using a cryptographically strong random number generator.

**7**. The method of claim **1** wherein the one-time use access code expires after a predetermined time period if not earlier used to access the locking mechanism.

**8**. The method of claim **1** further comprising opening the locking mechanism using the one-time access code.

**9**. A computer-based service configured to dispense one-time use access codes for remotely located locking devices in response to requests therefor wherein transaction fees are assessed for each access code dispensed.

**10**. The service of claim **9** wherein the access codes are dispensed from a server accessible through at least one of the Internet, a wireless network or the public switched telephone network.

**11**. The service of claim **9** wherein each access code so dispensed expires upon the earlier occurrence of (i) its use to access an associated one of the storage devices, or (ii) a predetermined time period.

**12**. A locking mechanism, comprising:

an actuator configured to unlock in response to entry of an authorized access code; and

an access code entry unit configured to accept a one-time use access code issued by a remote server, wherein the one-time use access code comprises a package tracking number.

**13**. The locking mechanism of claim **12** wherein the one-time use access code comprises a number generated by a cryptographically strong random number generator.

**14**. The locking mechanism of claim **12** wherein the one-time use access code is transmitted to the locking mechanism from the server.

**15**. The locking mechanism of claim **12** wherein the one-time use access code is stored in a memory associated with the locking mechanism.

**16**. The locking mechanism of claim **12** further comprising an interface unit configured to communicate with the server.

**17**. The locking mechanism of claim **16** wherein the interface unit is configured to communicate with the server through a second interface unit.

**18**. The locking mechanism of claim **12** wherein the actuator includes a microcontroller coupled to receive inputs from the access code entry unit.

19. A method, comprising:

receiving, via the Internet at a computer-based unit, a code to be used as an access code for a locking device; and

transmitting the access code to the locking device.

20. The method of claim 19 wherein the transmitting is done via the Internet.

21. The method of claim 19 wherein the code comprises a package tracking number.

22. The method of claim 19 wherein the code is provided by a delivery service or merchant.

23. The method of claim 19 wherein the code is provided by an owner of the locking device.

24. The method of claim 19 wherein the access code expires after it is used.

25. A method, comprising:

receiving at a computer-based unit a request for an access code for a locking mechanism; and

issuing from the computer-based unit, and according to a list of currently available access codes for the locking mechanism that is a subset of access codes for the locking mechanism, a one-time use access code for the locking mechanism, wherein the access codes for the locking mechanism are generated using a cryptographically strong random number generator.

26. The method of claim 25 wherein the one-time use access code is issued in response to a request received from a merchant or delivery service.

27. The method of claim 25 further comprising updating the list of available access codes in response to an indication that a code has been issued or used.

28. The method of claim 25 further comprising updating the list of available access codes in response to an indication that a code has expired.

29. The method of claim 25 wherein the one-time use access code expires after a predetermined time period if not earlier used to access the locking mechanism.

30. The method of claim 25 further comprising opening the locking mechanism using the one-time access code.

31. A method, comprising:

receiving at a computer-based unit, a code to be used as an access code for a locking device; and

transmitting the access code to the locking device, wherein the access code comprises a package tracking number.

32. The method of claim 31 wherein the transmitting is done via the Internet.

33. The method of claim 31 wherein the code is provided by a delivery service or merchant.

34. The method of claim 31 wherein the code is provided by an owner of the locking device.

35. The method of claim 31 wherein the access code expires after it is used.

36. A locking mechanism, comprising:

an actuator configured to unlock in response to entry of an authorized access code; and

an access code entry unit configured to accept a one-time use access-code issued by a remote server, wherein the one-time use access code comprises a number generated by a cryptographically strong random number generator.

37. The locking mechanism of claim 36 wherein the one-time use access code is transmitted to the locking mechanism from the server.

38. The locking mechanism of claim 36 wherein the one-time use access code is stored in a memory associated with the locking mechanism.

39. The locking mechanism of claim 36 further comprising an interface unit configured to communicate with the server.

40. The locking mechanism of claim 36 wherein the interface unit is configured to communicate with the server through a second interface unit.

41. The locking mechanism of claim 36 wherein actuator includes a microcontroller coupled to receive inputs from the access code entry unit.

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